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1994. Pages 275-279 *in* C. H. Racine and D. Cate, eds., Interagency Expanded Site Investigation: Evaluation of White Phosphorus Contamination and Potential Treatability at Eagle River Flats, Alaska - FY 93 Final Report. Prepared by U.S. Army Cold Regions Research and Engineering Laboratory for U.S. Army Garrison, Alaska Department of Public Works. 396 pp.

VII-2. LABORATORY EVALUATION OF A METHYL ANTHRANILATE BEAD FORMULATION FOR REDUCING MALLARD MORTALITY AND FEEDING BEHAVIOR

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INTRODUCTION

In 1992, laboratory studies were conducted to evaluate the repellency of two methyl anthranilate (MA) bead formulations to captive mallards (*Anas platyrynchos*) (Cummings et al. 1993). DP920324B applied at 5.4 kg/ha was ineffective in reducing the number of duck entries into simulated test pools. Examination of the test pools indicated that the structure of the beads were pliable and would not break under duck bill pressure. Experiments with SE920326 at application rates of 5.4 and 10.8 kg/ha showed slight treatment effects. These application rates provided marginal bottom coverage, precluding ducks from encountering sufficient numbers of beads during each feeding bout to effectively deter them from the pools. SE920326 applied at 21.7 kg/ha to bottom sediment was sufficient to cause almost complete avoidance of treated simulated ponds and indicated that ducks were likely to respond more positively on subsequent treatment days than with lower application rates. In addition, this application rate suggests that there were residual effects in that ducks exhibited learned avoidance behavior following the treatment. However, field studies conducted in 1992 indicated a loss of the effectiveness of MA after 10 days (Clark et al. 1993). Two possibilities existed for the reduced performance in the field. The matrix may have been permeable to MA, but the problem more likely occurs because the MA formulation was dissolved in an oil. Because MA has a higher affinity for oil than water, the MA is more likely to stay within the capsule as long as the oil does not permeate the alginate outer wall. Changing the outer wall to decrease permeability to oil and reincorporating the core to an oil/MA might contain a 15% concentration of MA and a half-life of 10 days. If this could be achieved, the beads should retain their effectiveness in the field for the duration of the spring or fall migration period and would require only one application per season.

This study tested a modified MA formulation that was encapsulated at 15% MA by weight in a food-grade material coated with a water-impermeable material. The MA formulation was evaluated in a simulated pond setting to determine the effects on feeding behavior of mallards.

We gratefully thank Steven Bird, U.S. Army Environmental Center for providing funding and support for this project. The Denver Wildlife Research Center Animal Care Section provided technical assistance. We followed criteria outlined by the Animal Welfare Act and the DWRC Animal Care and Use Committee during this study.

METHODS

We obtained a bead formulation, JR930413, containing 15% entrapped MA in a food-grade material from PMC Specialties Group, Inc, Cincinnati, Ohio.* The material was formed into beads about 3–4 mm in size and coated with an impermeable polymer. The beads were structured to release at the minimum mallard bill pressure (1 psi) (Cummings et al. 1993).

Adult mallards were obtained from a captive wild mallard population housed at the Denver Wildlife Research Center. Captive mallards were banded with U.S. Fish and Wildlife Service numbered bands and weighed at periodic intervals. The mallards were housed in one of two holding pens (54 and 96 m^2) at DWRC, Denver, Colorado, and quarantined for at least 14 days before testing.

After quarantine, eight mallards (four males and four females) of similar weights were selected for use. A single mallard was selected randomly and housed in a 2- × 2- × 2-m test pen in an aviary and was acclimated for four days prior to collecting pretreatment data. Each mallard had free access to food and water. The floor of each pen was elevated about 20 cm and covered with Dri-deck® matting. A circular pool 1 m in diameter and 20 cm deep was inserted into the floor so that the water height was the same as the floor. Mallards were able to enter the pool directly from the floor.

* Use of a company name does not imply U.S. Government endorsement of their products.

We conducted the experiment between 0800 and 1600 for a seven-day pretreatment and a ten-day treatment period. The bead matrix was designed to settle to the bottom of the pool and only release MA when broken by feeding mallards. The bead formula was applied to the pool at 21.7 kg/ha, or about 7 beads/cm^2, so that mallards would encounter it when feeding off the bottom.

The number of entries each mallard made into the pool was recorded with a Trailmaster® motion detector. Each day, the motion detector was turned on to the data-gathering mode when the duck was outside of the pool to ensure that the first event recorded was an entry. At the end of each treatment day, data from the motion detector were recorded. A two-factor, repeated-measures ANOVA, with day as the repeated factor (treatment × sex × day), was used to assess whether time spent in the water varied among groups for the experiment. Duncan's Multiple Range test was used to isolate differences ($P < 0.05$) among means.

Prior to treatment, one 20-g sample of the MA formulation was collected for subsequent verification of the chemical concentration. In addition, each treatment day, one sample of water (20 mL) was collected from each pool for MA residue analysis. All samples were shipped to Monell Chemical Senses Center for analysis.

RESULTS

The average number of minutes mallards spent in pools decreased significantly ($F_{6,16} = 7.64$; $P < 0.01$) to below pretreatment levels on day 2 posttreatment and remained until the completion of the study (Fig. VII-2-1). But there were no significant differences between sexes ($F_{1,6} = 0.04$; $P = 0.84$) and sex × day interaction ($F_{1,16} = 1.17$; $P = 0.31$).

DISCUSSION

MA bead formulation JR930413 was sufficient to cause almost complete avoidance of treated pools. Data indicated that ducks encountering MA were likely to respond positively on subsequent treatment days. This application rate, 21.7 kg/ha, suggests that there were residual effects because ducks exhibited learned avoidance behavior following treatment. In addition, higher application

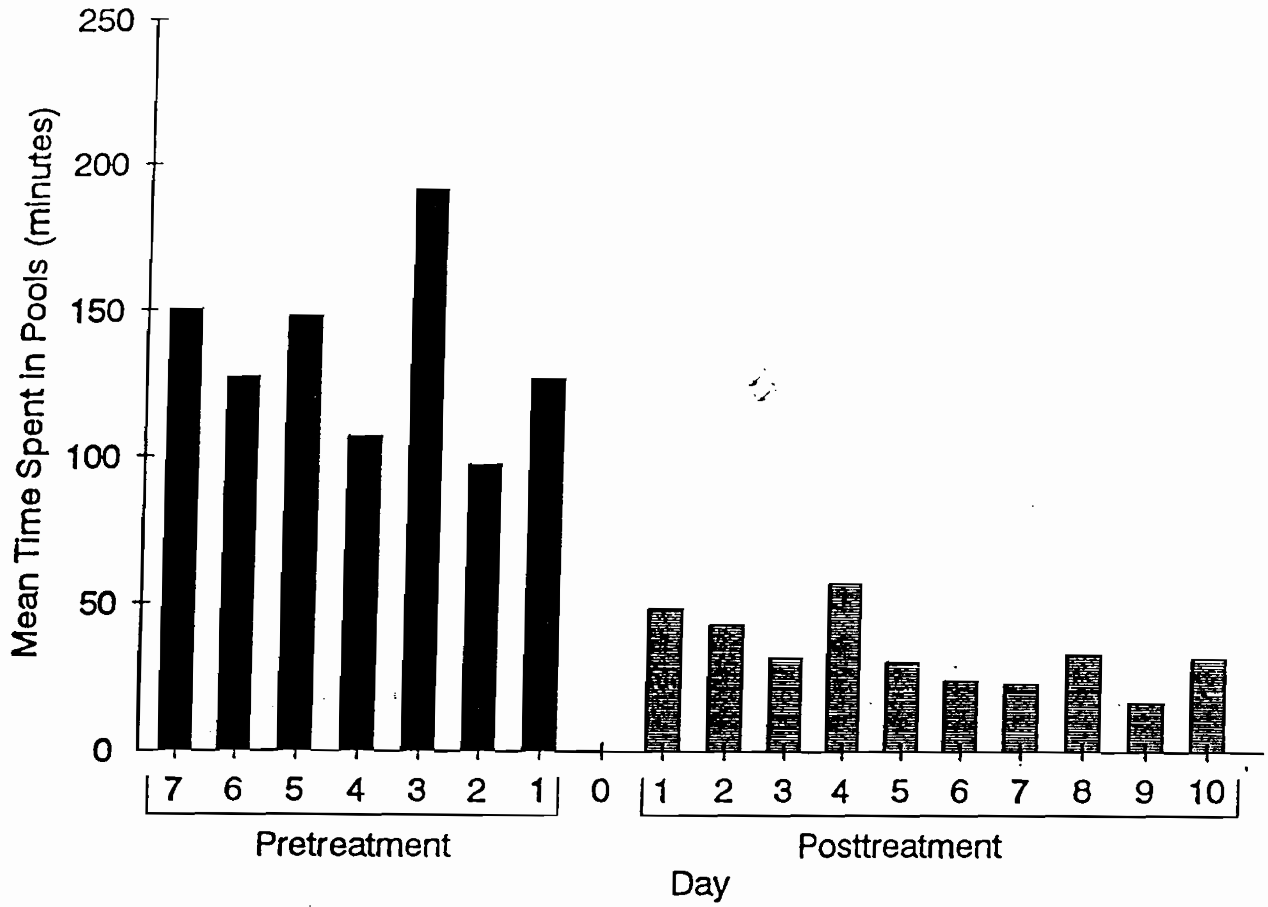

Figure VII-2-1. Mallard use of aviary pools treated with methyl anthranilate bead formulation JR930413A (15%) applied at 21.7 kg/ha, Denver, Colorado, 17 May–3 June 1993.

rates increase the possibility that ducks will encounter beads in sediment when feeding (Cummings et al. 1993). Thus, MA formulations would be most effective when the concentration remains at the repellency threshold (>2%) and ducks encounter MA beads during each feeding bout.

MA normally acts to repel birds from a resource or area, and, given the opportunity, birds will leave treated areas for alternative sites. ERF offers alternative feeding sites that are not contaminated with WP. Telemetry data indicate that the turnover rate of ducks using ERF, at least during the fall migration, is low, i.e. the same ducks reside in the Flats until departing in late September or early October. We feel that given the opportunity, wild ducks feeding in ERF would learn to avoid MA-treated areas. Thus, the use of MA could be an effective management tool to reduce duck use of contaminated areas. Field tests on ERF are warranted.

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